

Handbook for Preserving Archives of Aboriginal Language Materials

[Volume II]

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First Nations Education Steering Committee

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We have quoted from many sources in our effort to provide this information free of charge to First Nations in BC. If we have missed any attributions it was not our intent. Please let us know so that future versions may be attributed properly.



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Definitions

Analogue

Analogue is an older method of recording, which involves using an analogue – or copy – of a physical sound on magnetic tape. This method was often used in the past to store audio and video. It is hard to accurately duplicate using analogue recording as each generation of copies loses quality. An older tape-recorder is an analogue device. Note: we have used the Canadian spelling of analogue, instead of the common “analog”.

Archivist

The person who is responsible for the selection, preservation, and use of archival materials.

Compression

Compression is a digital process where file sizes are reduced through removing parts from the recording. Usually the parts that are removed are not missed. Compression is a way to save tapes by making the recording take less space. Due to the size of and subsequent expense of storing uncompressed video files, most users must compress video. Most digital video is automatically compressed in the camera to make tapes last longer. As audio files are not excessively large in terms of megabytes, audio files can be saved as uncompressed masters. However, compression can be useful for user copies (such as cassette tapes, or CDs).

Digital

“Digital” recording involves using a kind of a copy, but a very accurate copy; it makes a “clone” of a sound, converting it into bits and bytes (sometimes also on magnetic tape). Because the waves are numbers, not gradual continuous analogue waves, it is easy to duplicate a digital tape.

Digitizing Tapes

The process of taking older analogue cassette and reel-to-reel tapes (for example) and

updating them to digital files. Even though you would still keep the older tapes, this preserves the information stored on them as now you have two copies. Furthermore, the digital copies can be duplicated easily and with the same quality.

Magnetic media

This refers to any recorded tapes where information (sound or video) is recorded and retrieved in the form of a magnetic signal. The tapes or disks are coated with a magnetic layer to store analogue or digital waveforms.

Master tape

The master tape refers to the tape from which all copies are made. Sometimes this is the original recording, but as suggested in this handbook, it should be a high-quality digital tape, on which all the original analogue tapes have been copied to.

Normalization

Normalizing refers to making all the audio files the same volume level on a recording, as well as ensuring that the volume is as strong as possible. This is a technique to improve the sound quality for future generations. Can be done on analogue or digital recordings.

Optical media

This refers to any media format (a wide range of disk types) where the stored information (sound or video) is read optically, usually by a laser. For example, a CD or DVD is an optical media; the information is not magnetic.

Reformatting

The task of updating older digital archives to a more modern format, such as moving files from one older CD to a newer one. This should be done every 5-10 years to ensure that your CDs are still in good condition.

Introduction

First Nations communities across Canada have consistently expressed their commitment to maintaining and revitalizing their languages, and widespread efforts are underway to reach that goal. First Nations generally are striving to preserve the foundation that exists by recording the invaluable language and cultural knowledge of First Nations Elders and other people with expertise in this area. At the same time, First Nations are working to teach the language to new generations of speakers.

In British Columbia (BC), the First Nations Education Steering Committee (FNESC) has been working to assist First Nations with their critical efforts to promote their languages. To direct those efforts, First Nations representatives from throughout the province have come together to recommend and design a range of initiatives, including conferences, workshops, training programs, and research projects.

One of the projects previously recommended by First Nations in BC was a resource to assist people with effectively recording Aboriginal language speakers. The resulting Handbook on Recording Aboriginal Languages was released last year by FNESC. That tool has been said to be very useful in helping people to increase the quality of their recordings.

In completing the language recording handbook, other important issues were identified for review, including the need to archive existing resources. In particular, the care and treatment of valuable cultural recordings, both analogue and digital, was identified as a concern.

First Nations generally are striving to preserve the foundation that exists by recording the invaluable language and cultural knowledge of First Nations Elders and other people with expertise in this area. At the same time, First Nations are working to teach the language to new generations of speakers.

This handbook responds to the expressed need for information related to archiving materials. It has been written for people who do not have extensive technical expertise. It is intended to assist language teachers, community members, and anyone else who is interested in supporting language programs. FNESC hopes that it proves useful to those who are committed to preserving the knowledge of First Nations Elders and language speakers, so that their precious wisdom can be shared with generations to come.



Archiving Overview

1.1 What is archiving?

Archiving is the process of creating an archive. An archivist is the individual responsible for the selection, preservation, and use of archival materials. That work involves collecting valuable materials, organizing them in an effective way so that they can be accessed as appropriate, and implementing measures to ensure that the materials are protected and last as long as possible.

How does archiving relate to Aboriginal languages? As the *Aboriginal Language Program Planning Handbook* (Ignace, 1999) notes: *Especially for languages that are not well documented, [language reconstruction] means the recording and compiling of as much knowledge of the language from elders/fluent speakers as is possible, before it becomes impossible to collect such information. Reconstruction can involve the recording and compiling of vocabulary and expressions in dictionaries. It includes the recording, analysis and presenting of stories and legends, of life histories, of songs, proverbs, and all other kinds of knowledge of the language in taped and written form. It must also involve the documentation of the sound system (phonology) and grammar of the language.*

Archives can function as a First Nation’s collective memory. Materials that are carefully collected and stored can reveal how First Nations people lived in their traditional territories. They can also complement oral traditions by preserving in written or taped version the stories and information that have been passed down through generations. In addition, archives can protect historical and cultural materials, as well as information related to administration and governance.

Archiving relates to materials in a variety of forms, including photographs, written documents, and film. However, discussing ways to protect all of those media types is beyond the scope of this Handbook. This Handbook specifically addresses effective ways to archive sound and video recordings (magnetic and optical media).

1.2 Analogue vs Digital

Analogue or **digital** is the foremost consideration when talking about how a recording was created. We believe it is important to digitize your analogue recordings to make them into a digital format, as discussed below.

Currently, media being used to archive audio includes analogue cassette tapes and reel-to-reel and digital CD-R, DVD and hard drives. Media used to archive video includes analogue VHS and Betacam SP, as well as Digital Betacam, DVCAM, HDCAM, and even computer hard drives.

 **Analogue** is an older method of recording, which involves using an analogue—or copy—of a physical sound on magnetic tape.

 **Digital** recording also involves using a kind of a copy, but it is more accurate; it makes a “clone” of a sound, converting it into bits and bytes (sometimes also on magnetic tape).

The major difference between analogue and digital recording is in the conversion of the sound to tape. In this way, digital is much superior to analogue.



The process of converting sound or video into digital is the process of converting a physical sound or light wave into a series of numbers. For example, as all sounds are a physical wave, imagine a series of big ocean waves; in fact, you can see this if you hum across your coffee cup. If you took a cross section of one wave, you would see it start from the bottom, rise to the top, come down again, and then start again. Digitization just takes each stage of the wave and assigns to it a number. In effect, it “samples” a few places and makes a record of the number. So, if the beginning is zero, the wave at the mid-point of going up could be 1, the top could be 2, half-way coming down 1, and back to zero. Therefore, the wave could be represented as 01210. On the output side, that wave would be recreated as 01210. In reality, for CD quality sound, that wave would be sampled not 3 times, as in the example, but instead it would be sampled 44,100 times a second. That is known as “CD-quality” sound, and it gives a very accurate picture of that wave. Another way to look at this is a “connect-the-dots” picture. The dots have been recorded, and when played back, that dots just have to be connected! A last point related to the example is that the top number was 2. In fact, in CD quality sound, “16-bits” is used, which is a scale of 65,000 numbers.

Analogue recording can be thought of like a fax; it looks like the original, but it can be a bit blurry and sometimes it can be difficult to read. Also, imagine trying to fax a fax, and then fax that copy again. Would you be able to read the document now? Probably not, because every time it is copied, the process only captures the highlights and it loses the detail. After only a few generations it is unreadable.

Another way to think about analogue is to compare it to recording a phonograph album onto an audiotape. On most old tape decks, the copy always sounded “hissy.” If the recording was copied onto another audiotape, the sound was even worse. Once again, this is because the process of converting sound through an analogue method results in the capture of the highlights, but some of the sound details are lost.

Digital recording, on the other hand, preserves all of the details. Digital recordings also can be copied endlessly. Think about passing a digital file around on a computer disk. You can copy it many, many times. Of course, certain kinds of digital files, like those found on CD or DVD, can be protected so that it is difficult to make copies. Adding that protection, however, is a choice made by the manufacturer.

Another useful aspect of digital recordings is that they can be easily imported into the computer. That makes it easy to edit the recordings, as described in our *Handbook Volume 1*.

Of course, there are exceptions to the overall benefits of digital sound. For example, one important limit of digital recording is the level of digitization. There is a trade-off between file size and the quality of sound; the higher the quality of sound, the larger the file size. Why? Because higher quality digital files capture more information than lower quality files. Sometimes it may be difficult to deal with very large digital files, but the sound quality you achieve often makes any inconvenience worthwhile. That is a choice you can make when planning your project.

Overall, it is usually best to use digital recording whenever possible. Fortunately, doing so has become much easier due to the increase

of digital recording devices now available. Examples such as DVDs, miniDisc players, digital audio tape players, and digital video cameras can be found in many stores and/or through the Internet, allowing most people to take advantage of the high quality that digital recording can provide.

1.3 What is magnetic and optical media?

It is important to understand the kinds of media addressed in this handbook. Essentially, there are two major formats of recorded media —magnetic and optical.

Magnetic media is any recorded format where information (sound or video) is recorded and retrieved in the form of a magnetic signal. The tapes or disks are coated with a magnetic layer to store analogue or digital waveforms. Magnetic media can be analogue or digital.

THE COMMON TYPES OF MAGNETIC MEDIA ARE:

- magnetic tapes, including audio cassettes and reel-to-reel tapes, videotapes, and tapes used in digital recording processes, such as DAT; and
- magnetic hard disks, magnetic floppy disks or diskettes¹

Other examples of magnetic media include 3/4” video tape, halftrack or 1/4” audio tape, audio cassettes, VHS, S-VHS, Betacam, Betacam SP, Digital Betacam, Hi-8, Mini DV, DVCam, DVPRO, and computer hard drives.

Optical media includes a range of disk types where the stored information (sound or video) is read optically, usually by a laser. For example, a CD or DVD both use a laser to read the information on the disk. The information is not magnetic.

THERE ARE THREE MAIN TYPES OF OPTICAL MEDIA:

CD-ROM or **DVD-ROM** disks contain information that the user cannot change or add to (ROM stands for ‘read-only memory’). CD-ROM and DVD-ROM are the most common types of ROM disk. Most regular CD players that are built into computers read these disks.

CD-R disks are also known as read-write optical disks (or **WORM**, as in ‘write once, read many’). The most common form of this media type is a CD-R (recordable). CD-Rs are blank when sold. Primary users can record information on CD-Rs, and once written the information cannot easily be deleted or changed. Recording onto the disks requires dedicated hardware, such as a CD burner.

CD-RW or Rewritable optical disks – also known as **EO** (erasable optical) disks – allow the user to record information on a disk, readily erase it, and replace it with new data. The most common forms of rewritable disks are CD-RW and DVD-RW. They are used when information is being regularly revised, edited, or updated. Recording onto rewritable disks requires dedicated hardware.²



¹<http://www.aa.gov.au/recordkeeping/rkpubs/advices/advice5.html>

²<http://www.aa.gov.au/recordkeeping/rkpubs/advices/advice5.html>

Issues and Strategies for Archiving

2.1 Preservation and Accessibility

Preservation is an essential part of archiving. Ensuring that the media is well-kept and in good condition is key to being able to use it in the future.

Access is another essential aspect of archiving. It refers to the archived materials being available to those who need, and are authorized, to use them.

The topic of preservation is addressed in Section 3 of this Handbook. The following information relates to access.

2.2 Accessing archives using common formats

One important access issue is ensuring that copies of materials are in formats that are commonly available to the people who will be using them. For example, original recordings may be made in a high-end format, such as Digital Audio Tape. Doing so would be entirely appropriate, as it is very important that original recordings be of the highest possible quality. However, many community members would not have the technology required to use a Digital Audio Tape. Therefore, it would be most useful to copy the original (or more likely your edited master tape, described below) to a cassette tape or CD, both of which are more easily used.

2.3 Logging your Archives

Because language and culture resources are invaluable for teaching and encouraging language use, it is critical that all archived materials be organized in a practical and effective way. In addition to making the

recordings physically accessible, they must also be properly labeled. Keeping careful records of the information included on recordings is key to ensuring that they are actually used for their intended purposes. “Metadata” is another way of describing a description, or index, of the materials in the archive.

Labelling your data in similar ways as other archivists means that you can share information more easily. Libraries and archivists are attempting to develop metadata systems for audio and video materials, so they can be searched, indexed, and catalogued in a standardized way, in the same way that books are now organized.

While work continues in this area it is very important to take careful notes of what information is in your archives and to put that information into a searchable form, such as a database. The materials you produce will be most useful if a person can quickly find the information they need. For example, if a person requires information and stories about “frogs,” they should be able to type “frog” into a database to retrieve a list of relevant entries in your archives. That list will ideally identify the precise places on the relevant audio or video track where frogs are mentioned, avoiding extensive, time-consuming searches. Maintaining effective records of available information is especially relevant if the people who were involved in making the original recording are no longer available for assistance.

In addition to stories and words, audio and video recordings may also contain different types of information, such as music, gestures, and imagery. For example, in a video recording,



an Elder may demonstrate a cultural technique or show an artifact to illustrate a particular story. That valuable information may also be of great interest to people using the recording, and whenever possible it should be noted.

2.4 Access to Equipment

Often archiving is thought of as a one-time-only process. However, that is not the case; every five to ten years, collections must be revisited and, quite likely, reformatted.

While the archived materials themselves may not degrade over a five or ten-year timeframe, the devices required to use the recordings may become broken and/or obsolete. For example, in the 1970s many people used Beta videotapes. Today, that type of technology is no longer used, and the equipment used to play Beta videotapes is not widely available. For that reason, it would have been important for people to transfer materials recorded onto Beta Tapes onto other types of devices.

Make sure that when you choose equipment to record your archives, you are careful to protect and preserve the equipment you used. When using equipment that will not stay in your community, be sure to ensure to note model numbers and types of equipment so that you will be able to locate similar equipment in the future, although it is best if you have the equipment yourself.

2.5 Budgeting for archiving projects

When budgeting for an archiving project, remember that reformatting is suggested at least every five years. The process of reformatting includes the costs of new and replacement media, playback devices, new

storage solutions if necessary, and people to perform the reformatting, among other things. Keep in mind that as archives age, the cost of maintaining them and keeping them up-to-date will increase over time.

TO ESTIMATE THE COSTS OF ARCHIVING, YOU SHOULD CONSIDER THE FOLLOWING³

Hardware: the price, plus upgrades
This includes: playback decks, if needed; cables, Time Base Correctors or Video Processors; analogue to digital converters (outboard or on computers – sound card, or video capture card for PC’s), hard drives, computer or video monitors and cables, CD or DVD burners; and recorder decks and cables.

Dehumidifiers, if needed, for storage facilities; “sticky” mats; metal shelving; elevated work areas; sealed doors; proper drainage systems; insulation; UV filtered lights; a vacuum that can vent outside the storage/work area, or is HEPA 95% filtered; a temperature and humidity monitoring system.

Software: purchase price, plus upgrades
Audio and/or video capture software; CD/DVD burning software.

The cost of operations and maintenance (O&M)
Purchase or rent of a storage facility; cost of reformatting space (i.e. covering windows with dust and debris repellant material and tiling floors).

Replacement parts; maintenance/cleaning of equipment etc.

The cost of the media
The media itself, such as CDs, DVDs, DVCAM, MiniDV, DVCPRO50, D-9 or DigiBeta



TIP
The cost of the media is not simply the original purchase price, but rather the total (cumulative) cost over time. It also includes replacing a tape cartridge or disk because it has been worn out with use.

People:
a) The cost of the original recording
Technicians, travel costs, insurance (See *Aboriginal Languages Handbook Volume 1* for more information)

b) The cost of archiving
Technician and facilities personnel, travel costs, insurance.

c) The cost of digitizing or reformatting data
• Digitizing old analogue tapes into a new digital format. Include all costs for technicians.
• With storage over greater periods of time and increased access cycles, reformatting data because the tape cartridge or disk caddy is worn out must also be planned for
• Reformatting the data stored into a new format and onto a new media must also be taken into account. The reformatting cost includes all of the support software and hardware required to playback and copy the data.

2.6 Master Tapes

When making a recording—either video or audio—it is important to consider the creation of a “master” tape. For the purposes of this Handbook, a master tape is defined as the first generation copy of the original. The “master” tape is used to make additional duplicates and/or user copies. Ideally, it will be exact replica of the original if it is a digital copy, or the highest quality possible if it is an analogue copy.

Generally, it is best to have a digital master tape. For that reason, it is useful to transfer all original materials to digital format (which is discussed in more detail in later chapters). This is known as “digitizing” your analogue tapes.



- TIP**
- Always record your master on brand new tape.
 - Master copies and originals should be stored at separate locations.
 - Never lend your master. Only lend backups.
 - User copies can be made on lower quality materials (i.e. VHS tapes) while the master copy should be recorded on the highest quality and most stable media you can afford.
 - Every five years, reformat the master to protect it from obsolescence. Use the highest quality, most stable media your budget allows.
 - Never throw your original away, even if you feel you have an excellent master.
- In the event of a serious problem, save the master and/or the original before duplicates or user copies!

For audio recordings, digitizing means transferring materials to a digital format: CDR, DVD or hard drive. For video recordings, it means transferring materials to DV-CAM or hard drive. Store the analogue original and one digital master, preferably at locations that are separate from the copies and from each other. This will protect the materials in the event of problems such as fire or water damage. As described in more detail below, revisit and, if necessary, reformat the digital master every five to ten years.

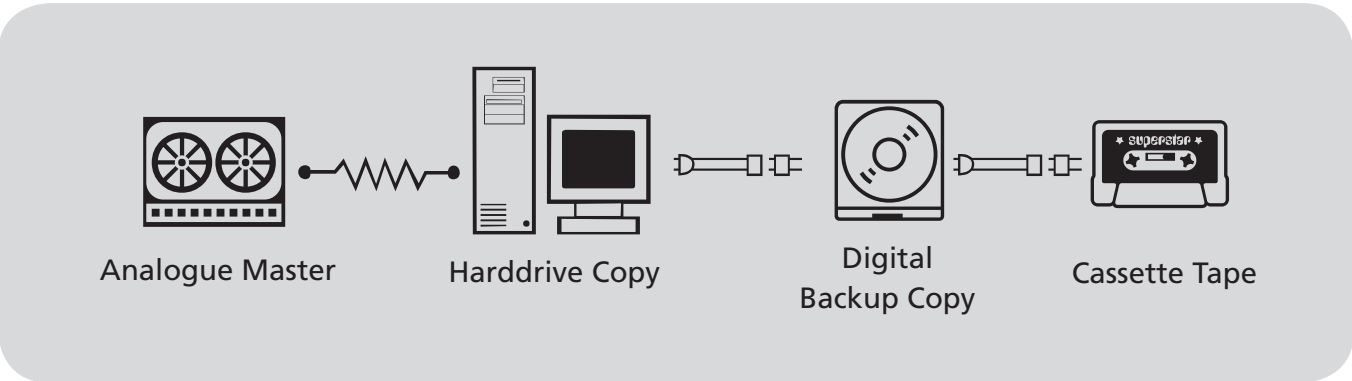
³adapted from “Existing And Emerging Technologies.” PRESTO – Preservation Technologies for European Broadcast Archives. 03 May 2001 <<http://presto.joanneum.ac.at/projects.asp#d31>>

Once created, the “new” digital master can be used to make copies for everyday use. It is better to make copies using the newly created master rather than the original, as doing so will prevent the original being damaged in the process of making numerous copies. As stated by the Association of Moving Image Archivists:

The principle means to prolonging tape life is to maintain an appropriate player, to keep original materials in stable, cool and dry storage conditions, and to strictly limit the use of original materials. An original tape should be used only for the purposes of making a preservation or secondary master from which additional copies can be produced for access.

Copies can be digital or analogue, and the quality does not have to be as high as it is the master. For example, it makes sense to copy your recordings to cassette tapes if you want people to listen to them in their homes, even though these are not the highest quality. CDs can also be used.

Copies are usually made to sound as clear as possible while the master should not be adapted in any way. While normalizing or compressing the tape might make the master sound better, always remember that you want to save as much of the original information as possible, as there may be more sophisticated methods for cleaning up tapes in the future. Unfortunately, with video some compression is almost impossible to avoid.



Preserving Your Recordings – Analogue and Digital Media

3.1 Media Quality

If you are recording or if you are transcribing old tapes to new formats, one important point to consider is the quality of the original media. Often, extremely inexpensive media is available for this purpose, which may be attractive for budgeting purposes. However, less expensive options often are not the best solution if you want the recording to last more than a few years.

It is important to buy quality CD-R's, DVD's and digital tape. In regard to CD-R, if quality media is used, recorded with quality equipment, then stored and handled with care, the media should last for many, many years. We have found that archival quality CD-R's last the longest, and some are Gold CD-Rs with “phthalocyanine-based” dyes. DVD is not as highly tested or recommended, although it is what most organizations are using to archive video and film. As discussed in more detail below, archivists should be prepared to re-archive DVD materials, if need be, in 5 to 10 years.

3.2 Media Degradation

 Another important issue to remember is that, over time, any physical media, whether optical or magnetic, will start to degrade. This means that the tape or CD physically starts to break down.

There are many methods for preventing media degradation. Factors that can prevent the premature degradation of your materials include proper physical handling and storage of the media, limiting the number of times it is played, and ensuring the quality of the tape. The second issue to consider in terms of media degradation is restoring damaged materials. That issue is considered in the following section.

3.3 Media handling – general

For handling tapes in general, there are many tips to prevent damage.

- Flakes of skin and oily fingerprints can damage tapes. Skin lotions can contain substances which break down tape. Handle the tapes as little, and as carefully, as possible.
- Do not eat or drink in usage or storage areas. Foods contain substances that can be destructive to magnetic tape. Foods also attract insects and animals.
- Ensure that your equipment is properly maintained. For example, make sure that tape guides are aligned.
- Use quality materials. Generally, buy known manufacturers of media and equipment.
- Buy media in quantity and sample for quality before beginning a transfer project.
- Preserve your originals!



FOR ALL MEDIA

- Keep your materials clean. Avoid contact with liquids, dust, smoke, or dangerous gases.
- Never open cartridges or touch written/tape surfaces.
- After writing/recording, set the write-protect switch.
- Apply labels to designated areas only.
- For transportation and shipping, package and label media adequately.
- In the event of a disaster, seek professional media cleaning help.

For tape

- Use only new stock when recording for long-term storage.
- Never stack things on top of, or put pressure on, unprotected tapes.
- Never drop or throw tapes.
- Never splice videotape.

For optical media

- Use Gold CDs for best longevity.
- Do not touch the recording side.
- Protect them from light.
- Label with water-based permanent felt markers. Do not write on the readable side of disks, or use regular pens, pencils or markers containing solvents. You may scratch the data layer, or the solvent may corrode the disk, making it hard to read. Only write on the top, near the centre of the clear center hub. Ideally, just write on the case.
- Do not use adhesive labels. Bubbles and creases in the label can unbalance the disk and adhesives can harm the physical structure. However, if a label has already been added, do not try to remove it.

- Protect both sides of disk from scratches. Even scratches on the non-writable side can damage the disk, making it unplayable.
- Clean dirt, fingerprints and smudges using a lint-free cloth. Wipe in straight lines from the disk’s centre. Do not wipe in a circular motion. If necessary, use CD/DVD cleaner, isopropyl alcohol, or methanol.
- Before recording, check the disk surface for damage or flaws.
- Leave recordable disks sealed until use.
- Don’t bend or flex disks.

3.4 Prevention

In terms of preserving Audio Visual materials, there are two key considerations. One is the preservation of the media itself, and the second is the preservation of the data on the media. This section reviews the preservation of the media—for example, 1/4” audio tape, audio cassettes, VHS, computer hard drives, CDRs and DVDs. Further sections of the *Handbook* will discuss preservation of the data, which is interpreted in this Handbook as digitizing analogue to digital formats.



3.5 Storage Conditions and Temperature

All media need to be handled with care. For instance, even the edges of CD-R’s are fragile and should be handled as little as possible.

VHS cassettes, Beta tapes, audio cassettes, CD-R’s and DVD’s all require dry, cool storage places, preferably away from light. Magnetic media require slightly different storage conditions than optical media. However there is enough overlap that the two can be housed together.

In general, here are some guidelines for storing your tapes. Please refer to the appendix for a more detailed breakdown. It is acceptable to keep tapes at room temperature with moderate humidity. However, make sure they are not exposed to large changes in temperature or humidity. Lowering air humidity with a dehumidifier is recommended during hot summer months or in damp areas.

	Suggested Temperature	Relative Humidity Range
Short term Storage	20°C/68°F	20%-30%
Medium term Storage	15°C/59°F	20%-40%
Long term Storage	10°C/50°F	20%-50%

STORAGE TIPS

- Conditions for storage are different than conditions for handling.
- Temperature and relative humidity need to be stable. Magnetic media expand and contract in response to temperature and humidity changes, which can cause playback problems.
- An air cleaner added to an air conditioner system can control humidity. If the storage room is well insulated, only a small dryer is needed.
- Tapes should be out of storage as little as possible.
- Prevent contact with perfumes, exhaust fumes, and fumes from ammonia and chloride-based cleaners.
- Never smoke in usage or storage areas.

Removal of Magnetic Tapes from Storage

If they have been in storage, tapes need

to be acclimatized before playback. If the temperature and humidity of the playback environment are significantly different from those of the storage area, give time for the tapes to acclimatize before you try to play them—usually at least 24 hours.

MEDIA HANDLING – STORAGE

⚠ Even the smallest particles of debris that are commonly found on magnetic recording tapes and in tape machines can cause playback errors – even a human fingerprint can create problems! Therefore it is important to take basic steps to avoid contamination, such as washing your hands before handling tapes and keeping the storage area clean. Check all media periodically (every six months is recommended); visually check for damage and random sample check to ensure it is still usable.

The following is a list of additional tips that can help preserve your media.

For CD

- Use the correct cases for all media types. Never use paper or cardboard.
- For CDs and DVDs, use the hard plastic cover “jewel” cases (not sleeves). Jewel cases provide more physical protection; they suspend the disk by the centre hole, keeping the written surface from contact with other surfaces. They provide protection against rapid temperature changes and often minimize the effects of magnetic fields.
- Archival quality CDs are made from polyester that does not emit chemicals harmful to media. Use them if you can. They can be purchased at many specialty audio stores.
- Remove paper from inside all cases.
- Store media vertically. Do not store flat (horizontally).
- Store one copy off site, if possible.

For reel-to-reel or cassette tapes

- Store with a “flat pack,” which means with the tape wound evenly on the spools. This creates a flat surface, preventing any tape from sticking up and being damaged.
To do this, wind the tape to the end and then rewind. Some tape units have a slow speed or “library wind.” Use that if possible. Repeat this process until the tape is wound flat on one reel, with no tape edges sticking up from the others (which often happens with regular playback). A tape’s control track—which is essential for a tape to “talk to” a playback unit—is at the edge.
- A good pack helps prevent damage to the control track, as well as minimizing “sticky shed syndrome” (which will be discussed later), “print-through,” which occurs when one layer of tape magnetizes another causing pre-echoes or “ghosting,” and avoids creased tape.

- Upright storage helps maintain a good “pack.”
- For analogue tape, store on the take up reel (“tails out”). This minimizes “print-through.”
- Do not store with tape exposed (i.e. half wound or unwound).
- On open reels, secure tape ends.
- Forward and rewind tapes every 12 months. This provides re-tensioning and re-packs the tape.



TIP

Fungus should be considered toxic. If you find fungus on a tape, consult a tape cleaning professional. Only personnel properly trained to remove fungus from tapes should do so. Otherwise, this can cause health problems.

MEDIA HANDLING - PLAYBACK



Playing tapes on dirty or poorly maintained equipment will readily damage tapes. Dirt on tapes and the playback unit can scratch tapes. Residue from degrading tapes can damage other tapes and equipment. For these reasons, playback units should be cleaned and maintained regularly.

1. Follow the instructions specific to your machine(s).
2. Use cleaning cassettes according to their instructions.
3. Clean tape heads and other components in the tape path with a cotton swab and a cleaning fluid recommended by the equipments’ manufacturer.
4. It is best to have a trained professional do the job. If you choose to do it yourself, be careful! Components are delicate and can be damaged easily.

To remove dirt, dust, and binder breakdown materials from tape, use a long fibre, lint-free, non-scratch cloth on both sides of the tape, making sure all debris is removed. For other cleaning, consult a professional, who will be trained in the use of specialized tape cleaning equipment.

For all media

- Before playback, inspect for damage or contamination. Clean or have them cleaned if necessary.
- Never force the media into cases or playback units.
- Never attempt to play a recording on a malfunctioning machine.
- Take the time to learn to use the equipment properly before use
- Drives can cause mechanical or heat damage. Remove media from playback equipment immediately after use.
- Maintain and clean equipment regularly.

For tape

- Before playback, forward and rewind the tape to equalize its tension.
- Never attempt to play or spool on dirty or misaligned equipment.
- Seat tape properly in equipment before hitting “play”.
- Avoid pausing during playback; a pause of more than 5 seconds stretches tape.
- Wind tape at low speed (library wind) entirely onto one reel after use. Make sure the pack is flat.

PLAYBACK PROBLEMS

If you experience poor playback, try the following tips.

1. Adjust tracking – refer to your equipment manuals on how to do this.
2. Clean tape guides.
3. Adjust tape tension.

4. Try another playback unit. Tape and playback unit construction change over the life of a format. Sometimes an earlier (or later) tape is not completely compatible with a late (or early) model machine.
5. A video processor or time base corrector (TBC) will often fix an unstable analogue video image. These are found in professional studios.

Tape with Damaged Edges or Warped Tape

Make sure that the pack is flat by rewinding and playing it through to the end. If the pack is still not flat, try a different machine.

Magnetism



One important note about all videotapes and other forms of magnetic media is a sensitivity to all magnets. Keep your tapes as far as possible from possible sources of magnetic fields. Magnets can be found in many places, such as speakers, magnetic cabinet door fasteners, motors and transformers (electrical equipment), and headphones. Magnetic fields are usually quite localized; a few centimeters distance from a source will generally protect magnetic media.

Moving Tapes



Tapes can be damaged when sipped and when moved within storage or handling areas. Whenever possible, ship duplicates instead of masters or originals. If you have to ship originals or masters make sure that the following guidelines are followed.

- Wrap each tape in bubble pack, with an additional layer at the bottom of the container. Make sure tapes are packed vertical and tightly.
- Do not use Styrofoam or other packing materials. These create dust that could damage tapes.
- If the tapes will be traveling through humid environments, seal each in a plastic bag with a small bag of crystals that absorb moisture

- (“dessicant”) which you can find at photo supply stores.
- Pack tapes with at least an inch of space between them and the outside of the packaging. This will protect against potential magnetic field damage.
 - X-ray equipment is safe for tapes.
 - Label all packaging: “fragile,” “this side up”!

3.6 Restoring Damaged Materials

How do you know when a tape is degrading? Specifically, the tape will begin to flake and there will be physical changes in the colour and the texture of the tapes. However, physical damage is often not noticeable to the human eye, so it is important to be pro-active in preparing for damage before it is obvious. If small black pieces can be seen falling off of the tape, this is very serious; your important recording is on those flakes! Sometimes, even fungus can appear on the tapes. More details about these and other issues are described below, but remember to treat fungus carefully, as inhaling it can be dangerous.

3.6.1 “Sticky Shed” Syndrome

“Sticky Shed” Syndrome is one of the main problems that occurs with tapes as they age. “Sticky shed” syndrome is a powdery substance or gooey residue on the tape. When this develops, the tape will typically play poorly, make excessive noise, or jam. If you play an old tape and any of those things occur, immediately

eject the tape and clean the playback equipment with isopropyl alcohol and cotton swabs.

Also, the polyester urethane that makes up the tape binding absorbs moisture over time, which makes tapes unplayable. High temperature and relative humidity (generally anything but controlled low humidity storage) stimulates that process.

To fix this problem, run the tape through a tape-cleaning machine, or dry it or bake it. Any of those processes will make it temporarily playable, but the tape will begin to absorb moisture again immediately after drying or cleaning. Therefore, the drying/cleaning process will have to be repeated throughout its life. It appears that tapes can be dried countless times with no negative effects. Nonetheless, it is recommended that you copy the dried tape onto fresh stock, or better, a digital format such as DVCAM. The copy and the original should be stored according to the details outlined above.

See the Appendices for more detailed information on drying and baking tapes.

Converting Media: Analogue to Digital

Remembering that analogue media includes older ¼”, ½”, cassette tapes, reel to reel tapes and older ¾”, VHS/Beta, and ½” videotapes, it is suggested that a good method of preservation is to transfer (digitize) these older tapes into a more modern digital format

There are several reasons to convert analogue materials to digital. Not only is analogue playback equipment becoming obsolete; the media itself can degrade. In addition, once materials have been converted to a digital format, they can be copied many times with no loss of quality. Finally, when digitizing analogue materials, user copies can be made which improve the quality of the material by applying normalization or compression.

However, digital copies are not the answer to every issue. Even if you transfer your analogue material to digital, it will likely have to be reformatted in five to ten years because new formats and equipment replace old ones at about that rate. It is difficult to predict which formats will be commonly used in ten years.

4.1 Video Conversion

4.1.1 Analogue Video

The following are some common Analogue formats and some facts about each. Ideally, these formats should be digitized. However, the analogue originals should be kept.

- VHS, the best known of analogue formats, was developed to make videotape recording readily accessible. As a result, high resolutions and longevity of tape life were secondary considerations to the cost of equipment and media. VHS is not a good archiving medium, though perfectly acceptable



TIP
If you are unsure what kind of videotape you have, check this guide:<http://www.video-id.com/>. It chronicles almost every one of the 50 different videotape formats in existence.

For audio formats, use this guide prepared by The Cutting Corporation: <http://www.cuttingarchives.com/FlipChart-Preservation.pdf>. http://www.videointerchange.com/audio_history.htm also offers photos of media and typical players or recorders, along with a bit of written history from 1877 to present.



for user copies as long as VCR's remain commonly available. An industrial grade VCR is preferable to a consumer-grade machine. S-VHS (Super-VHS) is a better format than VHS.

 **TIP**

Never use the analogue output of a digital tape player when copying a digital tape or transferring the information to another digital format. You will experience “generation loss” (loss of image and sound quality) that you would not experience if you kept the information in the digital format. Use the digital output only.

- Sony's Betacam SP (“Superior Performance”) is a popular analogue archival format, though tapes made with lower end recorders and media may not be suitable. Betacam SP is used less and less for archiving as more organizations are turning to digital media. It is only a matter of time before this format is extinct.

- Type C is another analogue format that was once popular for archiving, but it is no longer produced.

4.1.2 Digital Video

The main advantage of digital media is the fact that it can be copied many times without a loss of quality. Generally, image and sound quality is also better with digital video.

Most digital video cameras usually compress your recording to save on tape. Some expensive cameras do not. At this time, the amount of space it takes to store uncompressed video files makes it impractical to do so, except for those with larger budgets.

At this time, digital video, specifically, Digital Betacam, DVCPRO or DVCAM, are preferred to analogue formats for archiving.

Video, almost entirely due to its size, is more complicated to digitize than audio. A comprehensive preservation plan for analogue videotapes should be part of any digitization plan, because as the digital video medium becomes more and more popular, the technology will become more and more affordable. It may be only a few years before the storage of uncompressed digital video is a reality. Therefore, if your analogue tapes are kept in good condition, you may be able to transfer the media without giving up any image or sound quality.

For video, there are two important considerations when digitizing, as follows

- The format must do justice to the original tapes and be cost effective. We suggest either miniDV or DVCAM.
- Professionals will sometimes include one minute of colour bars and a 1,000 cycle per second test tone at 0/-12 VU on each audio track at the beginning of each tape. This provides a reference for future archivists. This step is not necessary if it seems too complicated.

The amount of disk space you need depends on the quality at which you capture your video and the length of your finished project. For example, 30 minutes of video recorded with a DV camera requires about 7GBs of storage on a computer. See the Appendix on the full chart showing storage requirements.

CHOOSING WHICH MEDIA TO STORE YOUR VIDEO

Once a transfer rate has been chosen, it is necessary to select an appropriate media for storing the digitized video. Backing it up on DVD, DLT or DAT tape is recommended. Storing the digitized video on CD-R is also possible, but as CD-R have limited storage space, several will be required for video.

In situations where multiple copies of data are stored on separate media, it may be best to use different media types for each copy, preferably with different base technologies (for example, magnetic and optical). Where the same type of media is used for multiple copies, different brands or batches should be used in each case, to minimize the risks of data loss because of problems with specific manufacturers or batches.

4.2 Converting Analogue Audio to Digital Audio

When converting analogue to digital audio, it is always best to convert files (or save as) to a common format such as WAV (.wav) format. Most digital audio experts say that this format is best for ensuring readability by a variety of playback units. The format is also said to safeguard against obsolescence. Save at “CD-quality” and burn it to CD or DVD. For distribution purposes, compressed MP3's or Real Audio files can be made from this master.

When evaluating which type of CD-R to buy, select archival CD-Rs with a gold reflective layer. Recent studies suggest that these “phthalocyanine-based” dyes are the most stable and have the greatest life span.

- Many voice recordings have a dynamic range of approximately 500 Hz to 3000 Hz, which is much lower than that of musical recordings.
- For copies for everyday playback, equalization can make voices more audible and reduce tape noises, making the content of your recording easier to comprehend.
 - Compressing the dynamic range (volume) – lowering low volumes and decreasing high ones – can further increase audibility of speech recordings. (Do not confuse this kind of compression with file compression).



When purchasing equipment and software, quality is important for clean signals and trouble free operation. Spending a little more for quality playback equipment, cables, sound cards, computers, software, CD recorders, and media will make a difference, both in making your process easier and more enjoyable, and in making your final product cleaner and clearer.

The Colorado Digitization Project mentions the Yamaha Core II system for a sound card, and suggests spending from \$275 to \$1000 US.

For recording software, Sound Forge (www.sonicfoundry.com), Cool Edit Pro (www.syntrillium.com) and Pro Tools (www.hitsquad.com/smm) are suggested.

For CD recorders, models that are external to computers should be made by manufacturers of audio products, as they will be designed specifically for audio recording rather than data storage. Yamaha, Teac and Sony are usually mentioned, which generally cost approximately \$225 to \$399 US.

Stand-alone CD recorders (which allow recording without a computer) from Tascam and Philips are suggested, with a cost of between \$400 to \$1000 US.

If using a computer for recording, it is best to use at least a 400mhz Pentium III with a minimum of 256mb RAM. You will need at least 10mb of disk space per minute of 2-channel CD quality audio.

A compression ratio of 2 to 1 will generally enhance a speech recording without changing it too much. Refer to an audio technician for more help with these techniques.

If you want to make your archives accessible to people who do not have high-end equipment, cassette tapes, CDs, and MP3s are all useful formats for copies. Almost 14 hours of MP3 audio will fit onto a CD, compared to 1 hour of WAV audio. MP3 is a popular format that can be read by many digital audio playback devices.

CASE STUDY: FROM ANALOGUE TO CD

The process of transferring analogue tapes to digital (in this case a CD) includes three parts:

- 1. playback of your original tape;
- 2. transferring this playback of the analogue signal to your digital input device; and
- 3. recording to CD.

You can complete this process using different methods and equipment.

The simplest method involves a playback unit and standalone CD recorder. You basically plug the audio out from your playback device, for example, a tape recorder, into the CD recorder (which looks like a large CD player). Follow the CD recorder instructions for set up and test the input (volume) levels so that your signal is strong.

However, a common method that you will probably want to use involves recording directly to the hard drive of a computer, and then recording from there to a CD. This process usually requires a soundcard, which allows you to record directly into your computer. Make sure that you buy a good one! CD burners generally come with CD burning software.

A diagram of a system following these guidelines:

[diagram to come]

4.2.1 Playback

When playing back reel to reel with both mono and stereo reels, use a stereo playback device. This is preferable to a mono device as you will lose the stereo aspect if you use mono only.

Pay attention to speed. You will know if the speed is incorrect, as the voices or music will sound too slow or too fast.⁴

Conclusion

First Nations throughout the province are striving to record the knowledge of Elders, language speakers, and other people who have expertise in language and culture issues. However, that documentation process is only one important component of sharing and protecting the information that exists. As suggested in this Handbook, the knowledge and records must also be carefully archived in order to ensure that it lasts over time. Archiving information is also critical in order to make the preserved knowledge accessible for educational purposes.

FNESC has created this Handbook in the hope that it will provide some useful information and suggestions for those people who are undertaking this important work. Any comments and recommendations for improving this Handbook are more than welcome, and can be forwarded to the FNESC office.



NOTES

⁴Most consumer reel to reel decks play at 3 3/4 IPS (inches per second) and 7 1/2 IPS, while many professional models play at 7 1/2 IPS and 15 IPS. Older decks also played at 1 7/8 IPS. You may need an older deck to play back older reel to reel tapes.

Appendices

6.1 Media Storage Tables

The UK National Archives recommends the following environmental conditions for short- and long-term storage. Note that for electronic media, 'long-term' may be less than 5 years.

Short-Term Storage		
Media	Temperature	Relative Humidity
Flexible Magnetic Disks	10-51.5°C	20-80%
Digital Audio Tape (DAT)	5-45°C	20-80%
Digital Linear Tape (DLT)	16-32°C	20-80%
Ultrium Linear Tape Open (LTO)	16-32°C	10-80%
Other Magnetic Tape Cartridges	10-45°C	20-80%
CD-ROM/R/RW	10-50°C	10-80%
DVD-ROM/R/+R/RAM/RW/+RW	10-50°C	10-80%
Solid State Media	10-50°C	20-80%
Mixed Collections	16-32°C	20-80%
Long-Term Storage		
Media	Temperature	Relative Humidity
Flexible Magnetic Disks	18-22°C	35-45%
Digital Audio Tape (DAT)	5-32°C	20-60%
Digital Linear Tape (DLT)	18-26°C	40-60%
Ultrium Linear Tape Open (LTO)	16-32°C	20-80%
Other Magnetic Tape Cartridges	18-22°C	35-45%
CD-ROM/R/RW	18-22°C	35-45%
DVD-ROM/R/+R/RAM/RW/+RW	18-22°C	35-45%
Solid State Media	18-22°C	35-45%
Mixed Collections	18-22°C	35-45%





6.2 Playback Checklist⁵

- ❑ Inspect the tape case. If it is damaged, it is likely that the tape is also damaged or contaminated.
- ❑ Smell the tape. If it smells musty, place it back in the case and contact a professional, as mould is probably growing on it. If upon opening the tape case there is a strong, waxy, or astringent odor that disappears quickly, the tape is probably suffering from sticky shed syndrome. If the tape is made of acetate and you smell “vinegar,” the basefilm is deteriorating. Treat accordingly before playback.
- ❑ Look for mould on the tape case and tape edges. It will be black, brown or yellowish, fuzzy or thread-like.
- ❑ Check the tape pack. Is it flat (no strands sticking up nor “hills and valleys” in the wind), not touching the flanges (edges of the reel), and tight, without gaps? Is the tape folded back on itself anywhere? Are any edges damaged? Is there “spoking” – the presence of a pattern similar to bicycle spokes in the pack? This indicates poor tension in the wind. If any of these conditions exist, consult a restoration expert.
- ❑ Check for liquid damage or debris on the tape or cassette.
- ❑ Check for white powder, crystallization, or brown or black flakes. All of those signs indicate sticky shed syndrome which may be treated by drying.
- ❑ Inspect a strand of tape on open reel tape. Look for dirt, discolouring, physical damage or anything that could indicate playback problems.

⁵<http://www.amianet.org/publication/resources/guidelines/videofacts/inspection.html>

⁶<http://www.lib.umd.edu/TSD/PRES/magneticsalvage.html>

6.3 Dealing with Flooding

In the event of an emergency⁶

- Salvage acetate tapes first, and masters and originals before copies.
- If tapes come into contact with dirty or salty water, rinse them in clean water as soon as possible. Do not let the tapes dry first. Tapes may remain wet in clean, room temperature water for several days if necessary.
- Do not subject tapes to extreme heat or cold. Air dry, dehumidify, or vacuum dry tapes without heat.

Open Reel Tapes

- Take the tapes out of canisters and remove fasteners.
- If the tape has been in contact with mud or sewage, rinse it in clean water. Only if absolutely necessary, use mild, perfume/ colour-free dishwashing soap (using as little as possible).
- If the tape pack is good, rinse the tape in distilled water, blot dry with a lint-free cloth, and air dry in a vertical position.
- If the tape pack is poor, do not blot. If water has gotten inside a poorly packed tape, use a rubber washer (grommet) to keep the tape from the flanges. Air dry vertically until the outside looks dry. Wipe the tape with special tape cleaning cloth. Copy as soon as possible.

Tape Cassettes

- If the tape is wet on the outside only, air dry. If it is wet inside, open the cartridge and follow the instructions for open reel tapes.

6.4 Baking

Baking is a quick method for drying tapes.



Do not bake acetate tapes!! Acetate was used until the late 1960’s, when manufacturers began using polyester urethane for its durability and cost. You can recognize acetate because it is translucent; polyester urethane is opaque.

What you need

- An electric oven that can maintain a temperature of 130° F, with a variation of less than 10°, plus or minus.
-  Do not use a gas oven! Gas generates water vapour, which will damage the tape! Do not use a microwave! They are totally inappropriate for baking tapes and will likely destroy them.
- A known-to-be-accurate oven thermometer or a lab thermometer. Consistent, accurate temperature is essential!

Steps

1. Remove tapes from cases.
2. Make sure that tapes are packed smoothly.
3. Place tapes in oven and bring oven slowly up to temperature.
4. Turn off oven and let it cool to room temperature.
5. Remove tapes, allowing them to further acclimatize to room temperature before playing.
6. Baking times vary from about two to eight hours. It is recommended⁷ that you flip your tapes every 1/2 hour.
7. Baking times are not critical. Still, it is better to under-bake than over-bake a tape. If a tape is still gummy after baking, simply return it to the oven until it is dry.

⁷<http://www.tangible-technology.com/tape/baking1.html>

⁸<http://audio-restoration.com/baking.php>

Convection ovens can be used, and might provide more even heat and better air circulation than a regular oven. Food dehydrators, such as the “Snackmaster II,” can also be used. Author and audio columnist Mike Rivers⁸, gets a stable, “perfect” temperature by replacing his oven light with a 100 watt bulb and running a muffin fan from a computer. Whatever you do, remember to keep the temperature between 130 and 140° F for the duration of the treatment.

Should you prefer to have a professional conduct this process, there are many sources available. Contact a local curator or library archivist in an urban area near you for names and contact information.

6.5 Drying Tapes

Drying, as described by the Association of Moving Image Archivists, takes longer than baking, but is safer and probably easier if you have many tapes to treat.

For a few tapes

For each tape, you will need

- a zipper plastic bag
- a desiccant (Silica gel with a colour indicator is recommended. After use, you can remove the moisture it has absorbed by baking the gel in an oven. It is ready for reuse when it reverts to its original colour)
- a “porous and permeable”(3) small pouch to put the silica gel into
- a refrigerator (You can put all of your tapes into one refrigerator!)

Steps

1. Remove tape from its case.
2. Place in zipper plastic bag.
3. Put desiccant into porous pouch, so it does not directly touch the tape, and place in zipper bag with tape.
4. Place zipper bag in refrigerator (not freezer!)

For many tapes

You will need

- a small enclosed room with clean shelves
- a dehumidifier (a portable Sears or Oasis model will do)
- a “hygrothermograph,” “datalogger,” or other device for recording the temperature and relative humidity of the room (4)

Steps

1. Put the dehumidifier in the room.
2. Monitor the room with the “hygrothermograph” or “datalogger”. Adjust the dehumidifier so that the room maintains a relative humidity level of about 30% throughout the process.
3. Remove each tape from its case.
4. Remove any condensation or debris from the tape and case.
5. Put each tape, in vertical position, on the shelves with its case next to it. The vertical position allows air to get inside and around each tape.

Leave the tapes until the drying process is complete. A minimum of a week is usually required. Some tapes can take up to a month.

Check the progress of the drying process by removing them from the refrigerator/room,

acclimatizing them to room temperature for a day or two, and attempting to play them. If they still will not play, return them to the fridge/room for a couple more weeks. Repeat this process until they play without problems.

Once dried, the tape will remain playable for a few weeks to a few months.

When the drying is complete, fast-forward each tape, then rewind. Do this in an environment similar to the one in which the tapes will be stored. Place each tape back in its case, then store.

6.6 Digital Video Format Descriptions

DVCAM. If you have many tapes to transfer to DVCAM tape, buy a deck. Video cameras come with only a three-year warranty, and the wear and tear caused by many transfers could be harder on the camera than the money saved by not buying a deck.

Sony Mini DV and DVCAM tapes are completely compatible. You can record in DVCAM format onto Mini DV and in Mini DV format onto DVCAM tape. However, only DVCAM format actually records at the reduced speed and takes advantage of the wider tape. If you want to take advantage of the sturdier physical condition of DVCAM tape, you can also use “Sony Excellence” Mini DV tape. That tape is double coated, giving it more strength and durability than regular Mini DV tape. “Sony Excellence” apparently is also less prone to “drop out”, which are small glitches where the magnetic particles fall off the tape.

At Matrix Video in Vancouver, BC, DVCAM 40 minute tapes sell for \$22.50 each in batches of less than ten. “Sony Excellence” sells for \$17.00 each.

Digital Betacam is a popular choice for archiving, although concerns (for all types of digital video tape) include compression and the physical strength of the tape. See the table on digital video tape types to compare compression ratios. DigiBeta media and equipment is significantly more expensive than other DV media and equipment. DVCPRO50 and Digital-S formats are in a good position to

take over the Digital Betacam market. Digital Betacam uses the least amount of compression and is therefore the preferred video tape archiving format.

Betacam SP is still being used to archive. However, as DV formats – even the least expensive ones like MiniDV – provide better quality, and as production of Betacam SP equipment is shutting down, this format is not recommended at this time.

HDCAM is still an extremely expensive, extremely new technology, so it is not considered in detail in this Handbook.



6.7 Digitizing Video Storage Space Table

Use the table below to estimate how much space you need .

Video Length						
transfer rates	30 sec	1 min	5 min	10 min	30 min	60 min
1 MB/sec., Offline quality M-JPEG	30 MB	60 MB	300 MB	600 MB	1.8 GB	3.6 GB
3.6 MB/sec., DV-format video	108 MB	216 MB	1.08 GB	2.16 GB	6.5 GB	13 GB
6 MB/sec., Medium quality M-JPEG	180 MB	360 MB	1.8 GB	3.6 GB	10.8 GB	1.6 GB
12 MB/sec., High quality 2:1 M-JPEG	360 MB	720 MB	3.6 GB	7.2 GB	21.6GB	43.2GB
24 MB/sec., Uncompressed	720 MB	1.4 GB	7.2 GB	14.4 GB	43.2 GB	86.4GB

⁹Final Cut Pro 3 User’s Manual p. 34

6.8 Media Selection Scorecard - From the British government's National Archives

Below is a table that compares some common media types.³ Each medium is scored for a variety of criteria on a scale of 1 (does not meet the criterion) to 3 (fully meets the criterion). In general, no medium that scores less than 12 overall should be considered.

Media	CD-R	DVD-R	Zip Disk	3.5" Magnetic Disk	DLT	DAT
Longevity	3	3	1	1	2	1
Capacity	2	2	1	1	3	3
Viability	2	2	1	1	3	3
Obsolescence	3	2	2	1	2	2
Cost	3	2	1	1	3	3
Susceptibility	3	3	1	1	3	2
Total	16	14	7	8	16	14



NOTES

